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Comparison of the second and third waves of the COVID-19 pandemic in South Korea: Importance of early public health intervention

Hye Seong^a, Hak Jun Hyun^a, Jin Gu Yun^a, Ji Yun Noh^{a,b}, Hee Jin Cheong^{a,b},
Woo Joo Kim^{a,b}, Joon Young Song^{a,b,*}

^a Division of Infectious Diseases, Department of Internal Medicine, Korea University College of Medicine, Seoul, Republic of Korea

^b Asian Pacific Influenza Institute, Seoul, Republic of Korea



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ABSTRACT

Objectives: To compare epidemiologic features of the second and third waves of the coronavirus disease 2019 (COVID-19) pandemic in South Korea.

Methods: Nationwide COVID-19 data were collected between 6 May and 30 December 2020. The degree of social activity was estimated using an Internet search trend analysis program for leisure-related keywords, including 'eating-out', 'trip' and 'get directions' (transportation). Demographics, transmission chains, case fatality rates, social activity levels and public health responses were compared between the second (13 August–18 September 2020) and third (4 November 2020–present) waves.

Results: In comparison with the second wave, the third wave was characterized by delayed strengthening of social distancing policies (3 vs. 15 days), longer duration (36 vs. >56 days) and a higher case fatality rate (0.91% vs. 1.26%). There were significant differences in transmission chains between the second and third waves ($P < 0.01$). In comparison with the second wave, the proportion of local clusters (24.8% vs. 45.7%) was lower in the third wave, and personal contact transmission (38.5% vs. 25.9%) and unknown routes of transmission (23.5% vs. 20.8%) were higher in the third wave.

Conclusion: Early and timely interventions with strengthened social distancing policies should be implemented to suppress and control the COVID-19 pandemic effectively.

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Introduction

To date, South Korea has experienced three waves of the coronavirus disease (COVID-19) pandemic since the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019 (Korea Centres for Disease Control and Prevention, 2020). The first wave (February–April 2020) was an outbreak related to religious groups in a situation when information about the disease was insufficient. Although both the second and third waves started with increasing social activity with poor social distancing, the spread was mitigated successfully by rapid strengthening of social distancing policies during the early stages of the second wave but not during the third wave. This study

compared the epidemiologic features of the second and third waves of the COVID-19 pandemic in South Korea.

Methods

Data collection

Nationwide COVID-19 data from the Korean Statistics Data Centre and Korean Ministry of Health and Welfare were collected between 6 May and 30 December 2020, including daily incidence of laboratory-confirmed cases, number of fatalities and patient demographics (Ministry of Health and Welfare (South Korea), 2020; Statistics Data Center (South Korea), 2020). Data on transmission chains were also collected, based on contact tracing from the Korea Centres for Disease Control and Prevention (2020). The start point for each wave was defined as the first day with >100 new cases of COVID-19 per day for 2 consecutive days, and the end point was defined as the last day before decreasing to <100 cases per day for ≥ 7 days. The second wave occurred

* Corresponding author at: Division of Infectious Diseases, Department of Internal Medicine, Korea University Guro Hospital, Korea University College of Medicine, Gurodong-ro 148, Guro-gu, Seoul 08308, Republic of Korea.

E-mail address: infection@korea.ac.kr (J.Y. Song).

between 13 August and 18 September 2020, and the third wave occurred from 4 November 4 to present. Demographics, transmission chains, case fatality rates, social activity levels and public health responses were compared between the second and third waves.

In order to estimate the degree of social activity, the daily search frequencies for leisure-related keywords, including 'eating-out', 'trip' and 'get directions' (transportation), were calculated using the trend analysis program NAVER (NAVER Corp., Seoul, Korea) (Naver DataLab, 2020). For each keyword, the relative search frequency was presented as the proportional change in search interest within a period, setting the maximum interest level at 100.

Statistical analysis

A descriptive analysis was performed, and demographics and transmission chains were compared between the second and third waves of the COVID-19 pandemic. Chi-squared test was used to compare the proportions of categorical variables between the two groups. Data were analysed using SPSS Version 20.0 (SPSS Inc., IBM Corp., Armonk, NY, USA). $P < 0.05$ was considered to indicate statistical significance.

Results

In South Korea, the number of new cases of COVID-19 per day increased distinctly from August to September 2020 (second wave) and from November 2020 to present (third wave) (Figure 1). South Korea had been in a state of low-level social distancing (level 1) from 6 May 2020, as the COVID-19 pandemic was under control (Table 1). However, as summer arrived, levels of social activity increased gradually, as shown by the search trend of leisure-related keywords, and the incidence of COVID-19 grew markedly from the Liberation Day rally on 15 August 2020 (Figure 1). On 16 August 2020, the Korean Government upgraded the social distancing level in Seoul to level 2 for early mitigation of the second wave. The number of new cases persisted at approximately

300 cases per day, and this peaked on 26 August 2020 with 434 cases. As such, the Korean Government increased the social distancing level in Seoul from standard level 2 to strengthened level 2 on 30 August 2020. Under the strengthened social distancing rules, social activity was reduced sharply, and the number of new cases decreased to <100 per day by 19 September 2020, marking the end of the second wave. The Korean Government downgraded the social distancing level to level 1 on 12 October 2020.

In the search trend analysis, the two peaks in 'eating-out' are thought to be the result of issuance of dining-out coupons by the Korean Government; these were intended to invigorate domestic expenditure amid the pandemic. Dining-out coupons were initially distributed in August 2020, but the scheme was halted abruptly as the daily occurrence of cases surged. Distribution was resumed mid-October 2020 after the second wave was over. The annual government-supported sales campaign (Korea Sale Festa) was launched on 1 November 2020. These economic stimulus measures resulted in increased social activity and decreased social distancing, as shown by the leisure-related search trend analysis ('trip' and 'get directions') (Figure 1). Since 4 November 2020, >100 cases have been reported daily. On 19 November 2020, approximately 2 weeks after the third wave started, social distancing policies in Seoul were strengthened slightly to level 1.5 under the new five-tier system (Table 2), but the number of cases continued to increase. Although social distancing policies were strengthened further to level 2 on 24 November 2020 and to level 2.5 on 6 December 2020, the third wave was not sufficiently controlled, and therefore continued (Figure 1).

Although both the second and third waves were triggered by increased social activity, social distancing policies were strengthened swiftly – due to concern about spread related to the Liberation Day rally – during the second wave but not during the third wave (Figure 1). During the third wave, the strengthening of social distancing policies was delayed (>2 weeks from onset), and stepwise enhancement was slower. Comparison of the second and third waves showed that the interval from the start of each wave to

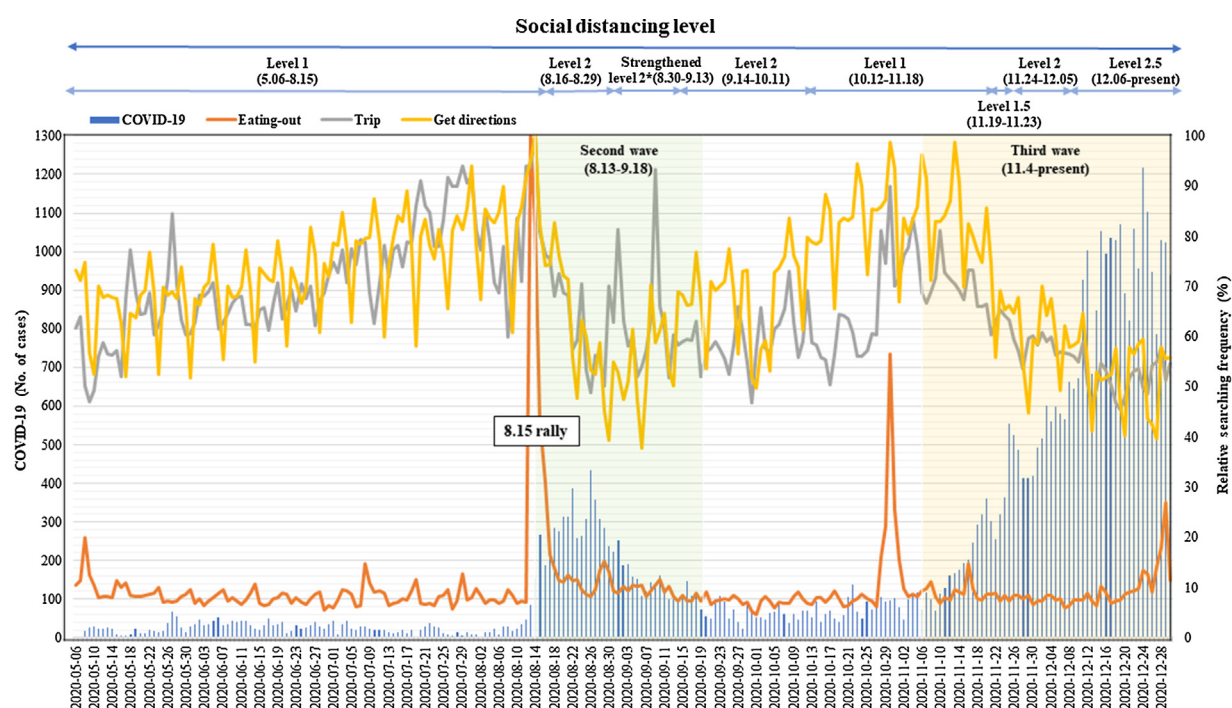


Figure 1. Changes in social distancing levels, social activity based on relative search frequency (%) for leisure-related keywords, and number of new cases of coronavirus disease 2019 per day from 6 May 2020 to 30 December 2020. COVID-19, coronavirus disease 2019.

Table 1

Three-level social distancing scheme during the second wave of the coronavirus disease 2019 (COVID-19) pandemic.

Outbreak status	Level 1 Repeated spread and mitigation of small-scale sporadic cases under the control of the healthcare system	Level 2 COVID-19 continues to spread in the community beyond what can be afforded by the conventional healthcare system	Level 3 Multiple cases of mass outbreaks in the community; COVID-19 is spreading rapidly and on a large scale
Number of daily cases	<50	50–100 cases	>100–200 or doubling twice within 1 week
Epidemiological link unknown	<5%	–	Sharp increase
Community transmission	Decreasing or under control	Steady increase	Sharp increase
Core restrictions			
Schools	Compliance with quarantine rules while attending both regular and remote classes	Combination of attending school and distance learning to reduce the number of students attending school, thereby minimizing gathering density	Suspension of classes at school: distance learning (online)
Social gatherings	Compliance with quarantine rules at gatherings, events and sporting events (with audience restriction)	Enforcement of an administrative order banning all private and public gatherings and events with ≥ 50 people indoors and ≥ 100 people outdoors. Sporting events continue with no spectators	All meetings where ≥ 10 people meet face-to-face are banned. All sporting events are suspended
Work pattern	The public sector utilizes flextime and telecommuting at an appropriate rate per departments. The private sector is encouraged to follow the same measures as the public sector	Flextime, telecommuting and staggered lunch hours for public sector employees. The private sector is encouraged to follow the same measures as the public sector	Except for essential personnel, all public sector employees to work from home. Similarly, private sector employees are recommended to work from home

Table 2

A revised, five-level social distancing scheme during the third wave of the coronavirus disease 2019 (COVID-19) pandemic.

Outbreak status	Level 1 Sporadic outbreaks	Level 1.5 Community transmission begins	Level 2 Full-blown community transmission	Level 2.5 Nationwide pandemic begins	Level 3 Full-blown nationwide pandemic
Number of daily cases	<100 (capital area), <30 (other areas)	>100 (capital area), >30 (other areas)	More than doubled after 1 week of level 1.5 social distancing. Continuing trends of level 1.5 in at least two areas. >300 nationwide	400–500	800–1000 nationwide
Core restrictions					
Schools	In-person class attendance capped at two-thirds of student body, with adjustments allowed	In-person class attendance strictly limited to two-thirds of student body	In-person class attendance capped at one-third of student body (high schools capped at two-thirds)	In-person class attendance capped at one-third of student body	Distance learning (online) for all
Social gatherings	Gatherings of >500 people require prior consultations with local authorities	Festivals and certain other types of gatherings with >100 participants are banned	All gatherings of >100 people are banned	All gatherings of >50 people are banned	All gatherings of >10 people are banned
Work pattern	Working from home is recommended for a proportion of workers per organization/division	Expansion of working from home is recommended	Expansion of working from home is recommended	Over one-third of employees are recommended to work from home	Mandatory working from home except for essential personnel

strengthening the social distancing policies was 3 and 15 days, respectively (Table 3). The second wave lasted for 36 days, but the third wave lasted for >56 days (as of 30 December 2020) and comprised more cases. More than 50% of cases were aged 20–59 years, with high levels of social activity during the second (56.0%) and third (60.0%) waves. However, the third wave had a higher case fatality rate than the second wave, as the absolute number of infections among elderly people was higher (1.26% vs. 0.91%). The transmission chains of the second and third waves of the COVID-19 pandemic differed significantly ($P < 0.01$). During the third wave, the proportion of local clusters was lower compared with the second wave (24.8% vs. 45.7%), while personal contact transmission (38.5% vs. 25.9%) and unknown routes of transmission (23.5% vs. 20.8%) were higher in the third wave than the second wave.

Discussion

In the absence of effective vaccines and antiviral drugs, social distancing is the only way to suppress the spread of SARS-CoV-2 (Ahmed et al., 2018; Noh et al., 2020). In this study, the most striking difference between the second and third waves in South Korea was the implementation of public health interventions. Unlike the second wave, when social distancing policies were strengthened rapidly, a large number of COVID-19 cases occurred in the third wave within a short time. Due to the short serial interval (3.9 days) and the highly transmissible nature of SARS-CoV-2, delayed intervention may have led to rapid spread in the community (Petersen et al., 2020). Thus, epidemiologic investigations and contact tracing could not be performed sufficiently,

Table 3

Comparison of characteristics between the second and third waves of the coronavirus disease (COVID-19) pandemic.

	Second wave (n = 8020)	Third wave (n = 33,690)	P-value
Time periods of COVID-19 pandemic	13 August–18 September 2020	4 November 2020–present (30 December 2020)	
Date of strengthening social distancing policies by Korean Government	16 August 2020	19 November 2020	
Sex, n (%)			<0.01
Male	3663 (45.7)	16,985 (50.4)	
Female	4357 (54.3)	16,705 (49.6)	
Age (years), n (%)			<0.01
0–9	280 (3.5)	1381 (4.1)	
10–19	438 (5.5)	2274 (6.7)	
20–29	943 (11.8)	4447 (13.2)	
30–39	890 (11.1)	4353 (12.9)	
40–49	1042 (13.0)	4976 (14.8)	
50–59	1612 (20.1)	6440 (19.1)	
60–69	1660 (20.7)	5341 (15.9)	
70–79	835 (10.4)	2620 (7.8)	
≥80	320 (4.0)	1858 (5.5)	
Classification of transmission chain, n (%)			<0.01
Local clusters	3977 (45.7)	8764 (24.8)	
Personal contacts with previous confirmed cases	2254 (25.9)	13,606 (38.5)	
Imported cases	538 (6.1)	1599 (4.5)	
Hospitals/nursing homes	119 (1.4)	3043 (8.6)	
Unknown	1813 (20.8)	8294 (23.5)	
Case fatality rate, n (%)	73/8,020 (0.91)	425/33,690 (1.26)	0.01

and the proportion of unknown routes of transmission increased markedly during the third wave (Table 3).

The COVID-19 pandemic has raised a dilemma between economic stimulus and public health control. Both the second and third waves in South Korea started when social activity was increased to stimulate the economy, but there were inconsistencies in the public health response. To implement economic stimulus policies effectively, more detailed and thorough quarantine measures must be established. When a surge wave is detected, drastic and intensive measures must be applied rapidly. In addition to increasing social activity, as the pandemic continues, the public's fatigue for social distancing and decreased vigilance about COVID-19 are thought to have contributed to the larger third wave compared with the second wave. Public fatigue may gradually weaken the effect of interventions over time. As proposed in a dynamic modelling study, early pandemic waves develop with the relaxation of public interventions, but late pandemic waves in autumn and winter may be aggravated by

failure to enforce interventions due to public fatigue (Rypdal et al., 2020). Typical evolving patterns of COVID-19 pandemic waves have been observed in many countries.

This study has several limitations. First, the level of social activity was not estimated directly. Instead, a search trend analysis for leisure-related keywords was conducted, thereby presuming the level of social activity. The measure of population movement (Internet searches for restaurants, travelling, etc.) may, in part, be 'wishful thinking' due to restrictions on social distancing, rather than actual movements. Thus, this could be an instance of 'reverse causality'. Second, climate factors such as temperature, humidity and wind were not considered in this study.

In conclusion, early and timely interventions with strengthened social distancing policies should be implemented to suppress and control the COVID-19 pandemic effectively. If the initial response is delayed, the COVID-19 pandemic can spread explosively in local communities, making it difficult to control using subsequent social distancing strategies.

Conflict of interest

None declared.

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Ethical approval

Not required.

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